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Khakimov M.Sh., Berkinov U.B., Sattarov O.T., Ermatov B.R.

## FEATURES OF LAPAROSCOPIC FUNDOPLICATION FOR HIATAL HERNIA IN PATIENTS WITH HIGH BODY MASS INDEX

Tashkent Medical Academy

### Abstract.

The results of examination and surgical treatment of 22 patients who underwent laparoscopic Nissen-Rosetti fundoplication were analyzed. Depending on the constitutional features and body mass index, the authors proposed methods for introducing trocars and developed a computer program. The proposed software facilitates the determination of the most convenient points for the introduction of trocars, which makes it easy to manipulate the instrument without requiring their rearrangement, and thereby improves the clinical results of surgical interventions.

**Key words:** laparoscopic fundoplication, computer program, hiatal hernia.

### INTRODUCTION.

Currently, the frequency of patients visiting a doctor with esophageal hiatal hernias (EHH) of diaphragm is growing steadily. According to the WHO [1, 2], diaphragmatic hernias are the cause of pathological conditions in every second elderly patient in gastroenterological practice. Laparoscopic fundoplication by Nissen, by Toupet and other minimally invasive methods are increasingly applied for surgical treatment of EHH. The advantages of such interventions are obvious: the surgery is carried out through minimal incisions with the sizes of 10 and 5 mm that guarantees a cosmetic effect; precise work with tissues is improved owing to the optical zoom of the target surgical area and the patient's hospital stay is significantly reduced. Due to these merits, the number of such interventions is increasing progressively [3].

Yet, the frequent implementation of laparoscopic interventions for EHH has generated a number of unresolved problems associated with recurrence of the disease, the development of dysphagia and other complications during the postoperative period. In addition, the laparoscopic surgery for elimination of EHH is not a routine intervention and requires high skills of endoscopic surgery from the physician. This issue becomes even more tough when it comes to patients with a high body mass index (BMI). According to a number of researches, in this category of patients, the frequency of intra- and postoperative complications and the rate of recurrence of the disease after laparoscopic fundoplication increased by about 2 times and reached up to 14-15% compared to patients with normal BMI [4, 5].

One of the key points of solving this problem is to create a comfortable operating environment, which,

in our opinion, first of all, will be provided by choosing the right trocar placement for this category of patients.

Considering the statement mentioned above, the purpose of this study was to determine the optimal trocar sites when performing laparoscopic repair of EHH in patients with high BMI.

### METHODS AND RESEARCH MATERIALS

The results of the examination and selective surgical treatment of 22 patients with EHH and BMI of more than 30, who were hospitalized in the multidisciplinary clinic of the Tashkent Medical Academy in the period from 2014 to 2019, were analyzed. All patients were divided into two clinical groups. The control group included 10 patients who underwent standard laparoscopic fundoplication (LFP) according to Nissen-Rosetti. The trocar site for the patients of main group (12 patients) was determined according to the calculations of the computer program developed by us.

All analyzed patients had a sliding EHH (type 1 EHH according to Hill). There were 9 women (55.9%) and 13 men (44.1%). The age of patients ranged from 42 to 68 years (mean age was  $55.2 \pm 8.6$  years). Their average BMI was  $32.2 \pm 2.5$  kg / cm<sup>2</sup>. There were not any particular differences in the above parameters of discrepancies in the compared groups.

One of the features of performing laparoscopic fundoplication in patients with high BMI is the strict abidance of the patient's position on the operating table: it should be with the position of head-up (when head is lifted as much as possible) that is used in the compared groups.

The stages of laparoscopic fundoplication in the control group were as following:

Laparoscopic fundoplication (LFP) was performed by introducing five trocars into the abdominal cavity. In this case, the first 10 mm trocar (A) was introduced above the navel at an angle; the second (B) 10 mm trocar was introduced 1 cm below the xiphoid process in the midline; the third (C) 5 mm trocar was introduced along the midclavicular line to the right, 4 cm below the costal arch; the fourth (D) 5 mm trocar was introduced along the anterior axillary line on the left, 3 cm below the costal arch; a fifth (E) 5 mm trocar was introduced to the left of the midline, 4 cm below the costal arch, at the intersection with the line connecting the second and third trocars. Then, the standard stages of the operation were performed: cruroraphy, fundoplication with the formation of a tensioned fundoplication cuff, capturing the front wall of the fundal part of stomach and passing it by the esophagus, 3-4 steps away from the large curvature, carried out to the right behind the esophagus, in an amount that is sufficient to form a tension-free cuff, a first suture is applied, without tension between the anterior surface of the fundus of stomach on the left, the anterior surface of the esophageal-cardiac transition and the wall of the stomach held behind the esophagus, the suture is tightened with five knots, and then continue to form a continuous suture down, between the front surface of the bottom of the stomach on the left, the front surface of the cardia and the wall of the stomach drawn behind the esophagus, then continue suture between the front surface of the left side of stomach bottom and held behind the esophagus stomach wall without strain and a length of 5 cm, to form a full cuff.

In the main group, the points of introduction of instruments for laparoscopic hernia repair were determined on the basis of our program - the "Hernioplasty.exe", the program for calculating the insertion parameters of trocars for laparoscopic hernia repair, used to perform laparoscopic hernia repair for inguinal hernias (certificate from the Intellectual Property Agency of the Republic of Uzbekistan DGU No. 04043 on 10/04/2016). This access point selection program was also used to select access points for LFP.

To assess the effectiveness of the program for determining laparoscopic accesses, studies were conducted on the selection of optimal laparoscopic approaches for hiatal hernia.

According to the results, the distance of the working tools was from 5 to 10 sm, the depth of insertion of the tool was from 17-33 sm, and the

angle of introduction of tools was from 38 ° to 65 ° (Fig. 1.).

So, in the first position, the triangular shapes of the geometric image in the ABC position, with attitude to A, are located above the umbilical region at an angle of 45°, and in the ABD position at an angle of 60°.

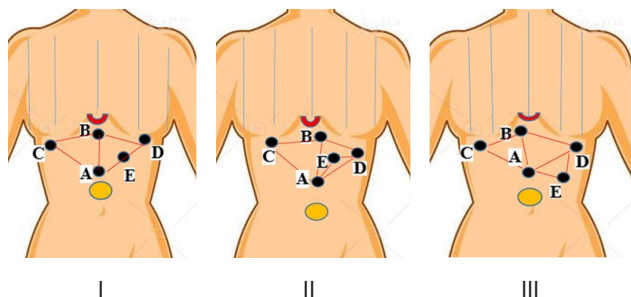


Fig. 1. Placement laparoscopic instruments by position

In this case, E is 2 cm lower along the drawn line from A to D points and with attitude to it they are at an angle of 120°. According to this type, LFP surgery was performed in 9 (37.5%) patients.

In the second position, the triangular shapes of the geometric image in the positions of ABC and ABD with attitude to A are located at an angle of 60°, i.e. in the form of two equivalent triangles. At the same time, E is at a central point along the line from A to D. For this type, LFP surgery was performed in 7 (30.2%) patients.

In the third position, the triangular shapes of the geometric image in the ABC position, with attitude to A, are located at an angle of 110°, and in the ABD position at an angle of 70°.

In this case, E is 2 cm higher along the drawn line from the A to D points and with attitude to it they are at the angle of 120°. For this type, LFP surgery was performed in 8 (33.3%) patients.

**RESULTS AND DISCUSSIONS**

In the control group, the duration of LFP surgery in patients with a body mass index (BMI) below 30 kg/sm<sup>2</sup> was on average 132.2±2.1 minutes, in patients with a BMI more than 30 kg/sm<sup>2</sup> lasted for 152.2±3.2 minutes. Due to the inconvenience of performing the manipulation and poor visualization of the fundus of the stomach, the trocars, standard points and angle degrees in 11 (47.8%) cases in patients with a BMI of more than 30 kg/sm<sup>2</sup> had to be intraoperatively reinstalled. So, in three cases, the working parts of the tools did not correspond to their jobs in relation to each other, where the surgery was



technically difficult and therefore the duration of the operation increased. In two cases, with the separation of the gastro-diaphragmatic and gastro-hepatic connections, damage to the diaphragm and the left lobe of the liver was noted. In the postoperative period, one of these patients showed pneumothorax on the left side, which resolved after thoracocentesis. In one (4%) case, during preparation of the gastric ligament, damage was noted to the branch of the left gastric artery where a hematoma was formed. In the postoperative period, the following complications were observed: seroma of wounds in the navel area in 3 (13%) patients, pain in the epigastric area in 3 (13%) patients, dysphagia in 1 (4%) patient who completely cured after conservative therapy.

Thus, due to the impossibility of the exact orientation of the working laparoscopic instruments in abdominal cavity and, without measuring the thickness of the soft tissue layers of the anterior abdominal wall, technical difficulties arise in the operation and thereby increase the number and frequency of complications in the early and late postoperative periods.

In order to improve the technical aspects of performing laparoscopic hernia repair and reduce intra- and postoperative complications, we developed a computer software, what allows us to determine the optimal combination of the introduction of trocars and working tools.

In the main group, for all patients prior to LFP were determined the parameters of the introduction of trocars and working tools according to our software.

In the main group, the duration of surgery in patients with a body mass index (BMI) below 30 kg/cm<sup>2</sup> was on average 110.3±1.8 minutes, in patients with a BMI more than 30 kg/cm<sup>2</sup> that pattern made up 115.1±2.4 minutes. Moreover, in patients with a BMI of more than 30 kg/cm<sup>2</sup>, the duration of the operation was shortened by 30-35 minutes than in the control group. There were not any intraoperative complications. The surgeries were completed without technical difficulties under adequate access to organs and good visualization. In the postoperative period, in two patients had pain in the epigastric region, which relieved the day after antispasmodic therapy. There were not any other complications.

The reduction in the average time of the LFP completion is associated with the exact reference point of the operation area and the correct choice of

the instrument insertion parameters, the absence of the need to reinstall working trocars along the abdominal wall. Patients after LFP were active as early as the next day after surgery.

**Clinical example:** Patient Z.Kh. 58 years old, clinical record No. 1104, complained of pain and discomfort in the epigastrium and left chest, shortness of breath, palpitation after having food. In anamnesis: the above mentioned signs over the past 5 years, associates with physical exertion. Anthropometric data of the patient: height 164 sm, weight 87 kg, BMI 34 kg/sm<sup>2</sup>. Diagnosis: Sliding esophageal hiatal hernia of the diaphragm. Obesity 2nd degree. Patient data on the surgery table at the request of a computer program: patient data corresponded to the third position in the geometric image of the instruments, and so, the distance from the table plane to the point of insertion of the instrument is 25 cm; the distance from the table plane to the area of operation on the skin is 21 sm; fat fold thickness - 3 sm; muscle aponeurotic tissue thickness - 1.2 sm (according to ultrasound); the distance from the insertion point to the operation area along the table plane is 17 sm. According to the result of the computer program for this patient, the distance of the instrument from the muscle layer was 9 sm, the instrument was inserted 22 sm deep at an angle of 47 degrees.



Fig. 2. Intraoperative view of the EHH

For the patient was performed LFP. In laparoscopy, there was a fairly adequate view of the gastro-diaphragmatic zone (Fig. 2.). The surgery went without technical difficulties. The duration of the operation was 106.8 minutes. There were no intraoperative complications. In the postoperative period, the patient was activated on the next day (Fig. 3.). We did not noted any complications. The nasogastric tube was removed on second day. The patient was discharged from the hospital on the 4th day of the surgery. Remote follow up period of 2 years. No recurrence.



Fig. 3. The patient is after LFP, 1st day.

Theoretically, laparoscopic hernia repair eradicates the risk of damage to the intra-abdominal organs and adhesions [6, 7, 8]. However, the method is time-consuming, since the working space is limited and orientation may be difficult. Surgeons cannot begin this operation until they gain the mastery of working with endosurgical instruments in order to freely navigate the anatomy of the preperitoneal space, in the inguinal region and at the same time,

improper insertion of the instrument increases the likelihood of damage to nearby organs of the inguinal region.

The software "Hernioplasty.exe" is calculated based on the parameters of the patient, i.e. thickness of subcutaneous fat and muscle-aponeurotic layer of the abdominal wall, height of the abdomen from the plane of the operating table in the horizontal position of the patient. The software "Hernioplasty.exe" allows you to calculate the parameters of the introduction of a working trocar along with a laparoscope. Based on the software calculations, the angle of insertion of the instrument into the umbilical region and the depth of insertion of the instrument are determined, which allow surgeons to easily manipulate in the area of operation.

Thus, the effectiveness of the program we developed for laparoscopic fundoplication is determined by the fact that the exact introduction of endoscopic instruments by the surgeon gives the correct orientation with attitude to the fundal region of the stomachs and the left cupola of the diaphragm, shortens the duration of the surgery and, reduces the frequency of intra and postoperative complications. In patients with morbid and supermorbid obesity, the use of this program makes easily manipulate the instrument without requiring their rearrangement.

Our studies have shown the clinical effectiveness of the complex of measures developed by us, not only when performing laparoscopic interventions on the organs of abdominal cavity, in particular, hiatal hernia.

## CONCLUSIONS

1. Performing laparoscopic hernia repair with the implementation of standard points of introduction for instruments in patients with high BMI presents certain difficulties due to the pronounced thickness of the soft tissues of anterior abdominal wall and increases of the risk for conversion or reinstallation of instruments.

2. The proposed software facilitates the determination of the most convenient points for

introducing trocars, which makes it easy to manipulate the instrument without requiring their rearrangement, and thereby improves the clinical results of surgical interventions.

3. The absence of complications in the intra- and postoperative period, proves the highly specificity and effectiveness of the proposed program for laparoscopic correction of EHH and is the key to reducing the risk of recurrence.

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